National Aeronautics and Space Administration
Goddard Earth Science
Data Information and Services Center (GES DISC)

README Document for the TIROS-4 Low-Resolution Omnidirectional Radiometer Level 1 Radiance Data

TIROS4L1ORR

Last Revised 11/19/2021

Goddard Earth Sciences Data and Information Services Center (GES DISC)
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Revision History

Revision Date	*Changes*	*Author*
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Table of Contents

1. Introduction

This document provides basic information on using the Low-Resolution Omnidirectional Radiometer Level 1 Omnidirectional Radiometer Radiance (or ORR) data product from TIROS-4.

1.1 Data Product Description

The TIROS-4 Level-1 Low-Resolution Omnidirectional Radiometer Radiance Data product contains the radiances derived from the black and white sensor temperature values from the hemispheric bolometers, and used to study the Earth's heat budget. Each radiance value is located with respect to latitude and longitude. The data were originally created on IBM 7094 computers and copied to 7-track, 556 bpi tapes in IBM's BCD format. Subsequently these were written in ASCII text format and saved to 9-track tapes and 3840 tape cartridges . The data from these magnetic tapes were recovered and are now archived in digital files in their original file format.

The data product is available for the time period from 2 February 1962 to 10 June 1962. There are two files, each containing a couple of months with several hundred orbits worth of data. The principal investigators for the TIROS omnidirectional radiometer experiment was Verner E. Suomi from the University of Wisconsin.

This product was previously available from the NASA National Space Science Data Center (NSSDC) under the name TIROS 4 Omnidirectional Radiometer Radiance Value Files with the identifier ESAD-00152 (old id 62-002A-01B).

1.1.1 Low Resolution Omnidirectional Radiometer

The TIROS low-resolution omnidirectional radiometer consisted primarily of two sets of bolometers in the form of hollow aluminum hemispheres, mounted on opposite sides of the spacecraft, whose optical axes were parallel to the spin axis. The bolometers were thermally isolated from but in close proximity to reflecting mirrors so that the hemispheres behaved very much like isolated spheres in space. The experiment was designed to measure the amount of solar energy absorbed, reflected, and emitted by the earth and its atmosphere. One bolometer in each set was painted black, and one was painted white. Both has a high absorptivity to the infrared radiation emitted from the earth. The black bolometer also had a high absorptivity for solar radiation, which provided for separation of the reflected and emitted radiation. The sensor temperatures were measured by thermistors fastened to the inside of the hollow hemispheres. The sensor temperatures, taken every 29 sec, were an average of the two temperatures from the matched thermistors.

The low-resolution omnidirectional radiometer was successfully flown on three TIROS satellites: TIROS-3 (launched 12 July 1961), TIROS-4 (launched 8 February 1962) and TIROS-7 (launched 19 June 1963). A similar instrument was carried on Explorer 7 (launched 13 October 1959).

1.1.2 TIROS-4 Overview

The fourth Television and InfraRed Observation Satellite (TIROS 4) was launched into orbit on February 8, 1962. Its design was similar to its predecessor TIROS 3, and was also equipped with the same experiments: two independent television camera subsystems for taking cloudcover pictures, plus a two-channel low-resolution radiometer, an omnidirectional radiometer, and a five-channel infrared scanning radiometer. With the exception of the degraded response of the five-channel scanning radiometer, the spacecraft performed normally until May 3, 1962, when one camera failed. On June 10, 1962, the other camera's tape recorder failed. The scanning radiometer provided usable data until June 30, 1962. The orbit characteristics for TIROS-4 were:

- Perigee Altitude: 712 km
- Apogee Altitude: 840 km
- Orbital Period: 100.00 minutes
- Inclination: 48.30 degrees
- Eccentricity: 0.00894

1.2 Algorithm Background

The TIROS low-resolution omnidirectinal radiometer data were generated from the spacecraft telemetry, attitude and orbital data. The data were originally processed on IBM 7094 computers, and subsequently copied to 6250 bpi 9-track tapes and 3480 tape cartridges for archival. More detailed information on the TIROS low resolution omnidirectional radiometer instrument and data processing can be found in section 6 (Suomi).

1.3 Data Disclaimer

Users should cite this data product in their research:

Suomi, Verner E. (2021), TIROS4 Level 1 ORT Data V001, Greenbelt, MD, USA, Goddard Earth Sciences Data and Information Services Center (GES DISC), Accessed: **[*Data Access Date*]**, https://doi.org/10.5067/F63AX3GWPHIZ

2. Data Organization

The TIROS low-resolution omnidirectional radiometer radiance data files contain between 10 and 26 days of data.

2.1 File Naming Convention

The data product files are named according to the following convention:

<Platform>_<Level>-<Type>_<DateStart>-<DateEnd>_<TapeNumber>-<FileNumber>.<Suffix>, where

o) Platform = name of the platform or satellite (TIROS4)
o) Level = process level (L1)
o) Type =- Data type is Omnidirectional Radiometer Radiance (ORR) data
o) DateStart/End = Data start date and end date in format <YYYY>m<MMDD> where
1. YYYY = 4 digit year (1962)
2. MM = 2 digit month (01 - 12)
3. DD = 2 digit day of month (01 - 31)

o TapeNumber = 4 digit number of tape (preceded by 'DR' - primary or 'DS' - backup)
o FileNumber = 3 digit number of file on tape
o Suffix = the file format (always TAP, indicating tape binary data)

```
File name example: TIROS4_L1-ORR_1962m0208-1962m0425_DR4232-001.TAP
```

2.2 File Format and Structure

The data are stored as they were originally written in IBM binary (big-endian) record oriented structured files. The files were eventually written on 6250 bpi 9-track tapes or 3480 tape cartridges using a blocked FORTRAN format. Each tape has two files on it, with each file containing about two months of data. Each data file on the tape contains a set of data records with a FORTRAN record size word, the record block representing a line of ASCII text, and a FORTRAN record trailing size word. Files end with a single End-of-File word, the last file on the tape is followed by a double End-of-File word.

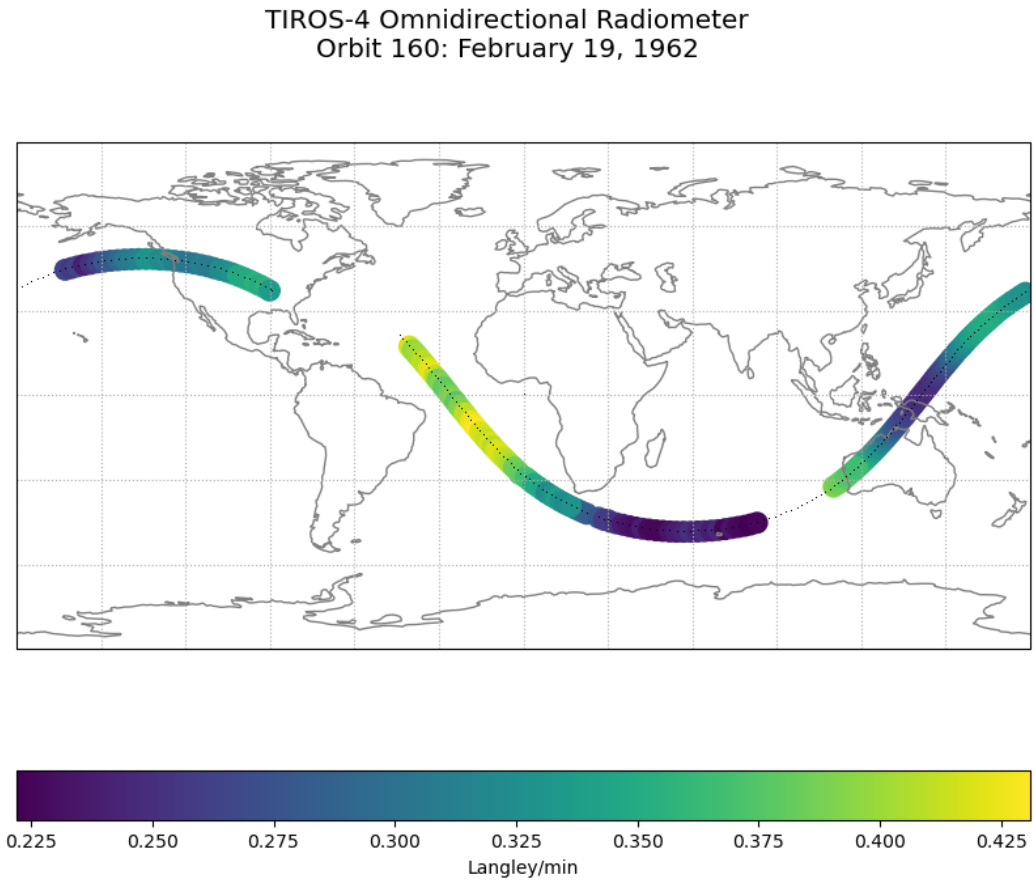
The lines of ASCII text make up a set tables of data with each table containing data for one orbit. The beginning of a table includes header information with the first line identifying the units of the long wave radiation and albedo columns, the TIROS mission, orbit number and date, followed by a second header line identifying the fields in each column. This is followed by rows containing the measured values listed in the header. The first header line column is marked with a 1, the second header is marked with a 0, and data rows have a blank ' ' character in the first column. The first data file contains 374 orbits of data, and the second file contains 297 orbits of data. For the contents and layout of the data, see section 3.1 below.

During data recovery there were two sets of tapes, The first set of tapes is the primary tapes which are designated with a DR (3480 tape cartridges). There is one DR tape containing two data files. The second set are the backup tapes which are designated with a DS (9-track tapes) again with one tape containing two files. The two data files have a couple hundred orbits of data. During recovery all of the DR and DS tape files were found to be exact or near duplicates (missing orbits) of each other. In the end there were 2 unique files from the primary DR tapes which represent the complete record of the TIROS 4 Level 1 ORR data collection and these are publicly available from the GES DISC.

2.3 Key Science Data Fields

The primary science data fields are the bolometer sensor temperatures expressed in degrees Celsius.

Figure 1: Typical data coverage and temperatures for a TIROS Level 1 ORR orbit



3. Data Contents

The granularity for the ORR data is about 2 months (10-26 days).

3.1 Data Records

No formal documentation describing the TIROS ORR data file format has been located.Each record or line is 120 characters long. A ‘1’ in the first column of a line indicates the beginning of a new orbit table, a ‘0’ in the first column indicates the column header, and those with a blank character contain the data values. Note there are no time stamps for the measurements, but from the Omnidirectional Radiometer Temperature product files, measurements are made every 29.5 seconds. A sample table is show below, and a description of each column is given in Table 3-1.

```
1UNITS - LWR %LANGLEYS/MIN<   AL %PER CENT<          TIROS IV     ORBIT NO.     1      FEB.   8 1962         0 DAYS
0C*  LAT  LONG  LWR AL  ZA    *C*  LAT  LONG  LWR AL  ZA    *C*  LAT  LONG  LWR AL  ZA    *C*  LAT  LONG  LWR AL  ZA
 8  47.2 321.5 .000  0   0     1   9.2  53.6 .362  0  73     1 -46.3 123.7 .257  0 111     1 -14.3 216.4 .307  0 109
 8  47.6 323.9 .000  0  33     1   7.9  54.7 .354  0  74     1 -46.7 126.0 .257  0 111     1 -13.1 217.5 .332  0 108
 1  47.9 326.4 .767-41  49     6   6.5  55.7 .299  0  74     1 -47.1 128.3 .238  0 112     1 -11.8 218.6 .353  0 108
 6  48.1 328.9 .243 39  57     1   5.2  56.8 .295  0  75     1 -47.7 133.1 .228  0 112     1 -10.5 219.6 .355  0 107
 1  48.3 331.4 .233 44  61     1   3.9  57.9 .270  0  76     1 -48.0 136.8 .229  0 113     1  -9.2 220.7 .356  0 106
 1  48.4 333.9 .213 49  63     1   2.6  58.9 .244  0  76     1 -48.0 135.5 .219  0 114     1  -7.9 221.7 .354  0 106
 1  48.4 336.5 .235 47  63     1   1.2  60.0 .264  0  77     1 -48.2 137.9 .247  0 114     1  -6.7 222.8 .365  0 105
 1  48.4 339.0 .230 46  63     1   -.1  61.0 .267  0  78     1 -48.3 140.3 .254  0 114     1  -5.4 223.8 .380  0 104
 1  48.3 341.5 .220 45  63     1  -1.4  62.1 .273  0  79     1 -48.4 142.8 .268  0 115     1  -4.1 224.8 .391  0 104
 1  48.2 344.1 .214 43  63     1  -2.7  63.1 .287  0  80     1 -48.4 145.2 .263  0 115     1  -2.8 225.9 .398  0 103
 1  48.0 346.6 .231 39  63     1  -4.1  64.2 .303  0  80     1 -48.4 147.7 .276  0 115     1  -1.5 226.9 .409  0 102
 1  47.7 349.1 .212 39  63     1  -5.4  65.2 .273  0  81     1 -48.3 150.1 .242  0 116     1   -.2 227.9 .410  0 101
 1  47.4 351.5 .203 38  62     1  -6.7  66.3 .276  0  82     2 -48.1 152.5 .000  0 116     1   1.1 229.0 .385  0 101
 1  47.1 354.0 .200 37  62     1  -8.0  67.4 .302  0  83     2 -47.9 155.0 .000  0 116     1   2.4 230.0 .362  0 100
 1  46.6 356.4 .191 38  62     1  -9.3  68.4 .304  0  84     2 -47.6 157.3 .000  0 117     1   3.7 231.0 .353  0  99
 1  46.1 358.7 .172 41  62     1 -10.6  69.5 .327  0  84     2 -47.3 159.7 .000  0 117     1   5.0 232.1 .360  0  98
 1  45.6 359.9 .169 41  62     1 -11.9  70.6 .345  0  85     2 -46.9 162.0 .000  0 117     1   6.3 233.1 .352  0  97
 1  45.0   3.3 .151 41  61     1 -13.2  71.7 .366  0  86     2 -46.5 164.3 .000  0 117     1   7.6 234.2 .373  0  97
 1  44.4   5.5 .140 43  61     1 -14.5  72.8 .355  0  87     2 -46.0 166.6 .000  0 117     1   8.9 235.2 .386  0  96
 1  43.7   7.7 .124 43  61     1 -15.7  73.9 .338  0  88     2 -45.5 168.8 .000  0 117     1  10.2 236.3 .390  0  95
 1  43.0   9.8 .142 39  61     1 -17.0  75.1 .344  0  89     2 -44.9 170.9 .000  0 118     1  11.5 237.4 .399  0  94
 1  42.2  11.8 .149 40  61     1 -18.3  76.2 .356  0  89     2 -44.3 173.0 .000  0 118     6  12.8 238.5 .332  0  93
 1  41.4  13.8 .175 39  61     1 -19.5  77.4 .361  0  90     2 -43.6 175.1 .000  0 118     8  14.0 239.6 .000  0  93
 6  40.5  15.8 .219 35  61     1 -20.8  78.6 .363  0  91     2 -42.9 177.1 .000  0 118     8  15.3 240.7 .000  0  92
 6  39.7  17.7 .263 31  61     1 -22.0  79.8 .381  0  92     2 -42.2 179.1 .000  0 118     8  16.6 241.8 .000  0  91
 1  38.7  19.5 .273 32  62     1 -23.2  81.1 .360  0  93     2 -41.4 181.0 .000  0 118     8  17.2 242.4 .000  0  90
 6  37.8  21.3 .313 28  62     1 -24.4  82.3 .359  0  93     4 -40.6 182.9 .000  0 118     8    .0    .0 .000  0   0
 1  36.8  23.1 .277 32  62     1 -25.6  83.6 .347  0  94     4 -39.8 184.7 .000  0 118     8    .0    .0 .000  0   0
 1  35.8  24.8 .282 32  62     1 -26.8  84.9 .337  0  95     4 -38.9 186.5 .000  0 117     8    .0    .0 .000  0   0
 1  34.8  26.4 .269 36  62     1 -27.9  86.3 .322  0  96     4 -38.0 188.2 .000  0 117     8    .0    .0 .000  0   0
 1  33.7  28.0 .289 35  63     1 -29.1  87.7 .352  0  97     4 -37.0 189.9 .000  0 117     8    .0    .0 .000  0   0
 1  32.6  29.6 .268 39  63     1 -30.2  89.1 .332  0  97     4 -36.1 191.5 .000  0 117     8    .0    .0 .000  0   0
 6  31.5  31.1 .309 34  63     1 -31.3  90.5 .343  0  98     4 -35.1 193.1 .000  0 117     8    .0    .0 .000  0   0
 1  30.4  32.6 .311 32  64     1 -32.4  92.0 .338  0  99     4 -34.1 194.7 .000  0 117     8    .0    .0 .000  0   0
 1  29.2  34.0 .323 30  64     1 -33.4  93.5 .328  0 100     1 -33.0 196.2 .284  0 116     8    .0    .0 .000  0   0
 1  28.1  35.4 .301 31  64     1 -34.5  95.0 .316  0 101     1 -32.0 197.7 .315  0 116     8    .0    .0 .000  0   0
 1  26.9  36.8 .303 31  65     1 -35.5  96.6 .297  0 101     1 -30.9 199.1 .333  0 116     8    .0    .0 .000  0   0
 1  25.7  38.2 .292 34  65     1 -36.5  98.3 .285  0 102     1 -29.8 200.5 .310  0 115     8    .0    .0 .000  0   0
 1  24.5  39.5 .317 33  66     1 -37.5  99.9 .299  0 103     1 -28.7 201.9 .303  0 115     8    .0    .0 .000  0   0
 1  23.3  40.8 .305 36  66     1 -38.4 101.7 .300  0 104     1 -27.6 203.2 .290  0 115     8    .0    .0 .000  0   0
 6  22.0  42.0 .346 30  67     1 -39.3 103.4 .300  0 104     1 -26.4 204.5 .289  0 114     8    .0    .0 .000  0   0
 1  20.8  43.3 .363 27  67     1 -40.2 105.2 .305  0 105     1 -25.3 205.8 .291  0 114     8    .0    .0 .000  0   0
 1  19.5  44.5 .367 27  68     1 -41.0 107.1 .297  0 106     1 -24.1 207.1 .304  0 113     8    .0    .0 .000  0   0
 1  18.2  45.7 .354 26  68     1 -41.8 109.0 .279  0 106     1 -22.9 208.3 .290  0 113     8    .0    .0 .000  0   0
 1  17.0  46.8 .387 21  69     1 -42.6 111.0 .265  0 107     1 -21.7 209.5 .288  0 112     8    .0    .0 .000  0   0
 1  15.7  48.0 .368  0  70     1 -43.3 113.0 .256  0 108     1 -20.5 210.7 .271  0 112     8    .0    .0 .000  0   0
 1  14.4  49.1 .351  0  70     1 -44.0 115.0 .255  0 108     1 -19.3 211.9 .256  0 111     8    .0    .0 .000  0   0
 1  13.1  50.3 .383  0  71     1 -44.6 117.1 .261  0 109     1 -18.1 213.0 .251  0 111     8    .0    .0 .000  0   0
 1  11.8  51.4 .381  0  71     1 -45.2 119.3 .258  0 110     1 -16.8 214.2 .269  0 110     8    .0    .0 .000  0   0
 1  10.5  52.5 .367  0  72     1 -45.8 121.5 .267  0 110     1 -15.6 215.3 .283  0 110     8    .0    .0 .000  0   0
```

Table 3-1: ORR Columns

Column	Name	Description	Units	Remarks
1		Line Identifier	-	'1'= new table '0' = header ' ' = data values
2 32 62 92	*C*	Measurement Code	-	Unknown, but for most non-zero data values this is set to 1
4-8 34-38 64-68 94-98	LAT	Latitude	degrees	-90 to +90
10-14 40-44 70-74 100-104	LONG	Longitude	degrees	0 to 360
16-19 46-49 76-79 106-109	LWR	Long Wave Radiation	Langleys/min	
21-22 51-52 81-82 111-112	AL	Albedo	%	
24-26 54-56 84-86 114-116	ZA	Zenith Angle	degrees	0 to 180
27-30 57-60 87-90 117-120		Empty		

3.2 Metadata

The metadata are contained in a separate XML formatted file having the same name as the data file with .xml appended to it.

Table 3-2: Metadata attributes associated with the data file.

Name	Description
LongName	Long name of the data product.
ShortName	Short name of the data product.
VersionID	Product or collection version.
GranuleID	Granule identifier, i.e. the name of the file.
Format	File format of the data file.
CheckSumType	Type of checksum used.
CheckSumValue	The value of the calculated checksum.
SizeBytesDataGranule	Size of the file or granule in bytes.
InsertDateTime	Date and time when the granule was inserted into the archive. The format for date is YYYY-MM-DD and time is hh-mm-ss.
ProductionDateTime	Date and time the file was produced in format YYYY-MM-DDThh:mm:ss.ssssssZ
RangeBeginningDate	Begin date when the data was collected in YYYY-MM-DD format.
RangeBeginningTime	Begin time of the date when the data was collected in hh-mm-ss format.
RangeEndingDate	End date when the data was collected in YYYY-MM-DD format.
RangeEndingTime	End time of the date when the data was collected in hh-mm-ss format.
PlatformShortName	Short name or acronym of the platform or satellite
InstrumentShortName	Short name or acronym of the instrument
SensorShortName	Short name or acronym of the sensor
WestBounding Coordinate	The westernmost longitude of the bounding rectangle(-180.0 to +180.0)
NorthBounding Coordinate	The northernmost latitude of the bounding rectangle(-90.0 to +90.0)
EastBounding Coordinate	The easternmost longitude of the bounding rectangle(-180.0 to +180.0)
SouthBounding Coordinate	The southernmost latitude of the bounding rectangle(-90.0 to +90.0)
Orbit	Orbit number range
ElapsedDays	Number of days in file.

4. Reading the Data

The data are written in a binary record-oriented format. Each record represents one line of text. The data were originally written in IBM BCD text, but were later converted to ASCII text format. Care should be taken as some lines of text do not always have columns that line up correctly, or may contain bad characters.

A sample FORTRAN program is included in the Appendix section which will read and print the the data contents.

Table 4-1: Orbit ranges for available tape files

File Name	No. Orbits	Orbit Range
TIROS4_L1-ORR_1962m0208-1962m0425_DR4232-001.TAP	374	1 – 1092
TIROS4_L1-ORR_1962m0425-1962m0610_DR4232-002.TAP	297	1093 – 1755

5. Data Services

5.1 GES DISC Search

The GES DISC provides a keyword, spatial, temporal and advanced (event) searches through its unified search and download interface:

https://disc.gsfc.nasa.gov/

5.2 Documentation

The data product landing pages provide information about these data products, as well as links to download the data files and relevant documentation:

https://disc.gsfc.nasa.gov/datacollection/TIROS4L1ORR_001.html

5.3 Direct Download

These data products are available for users to download directly using HTTPS:

https://acdisc.gesdisc.eosdis.nasa.gov/data/TIROS/TIROS4L1ORR.001/

6. More Information

6.1 Contact Information

Name: GES DISC Help Desk
URL: https://disc.gsfc.nasa.gov/
E-mail: gsfc-help-disc@lists.nasa.gov
Phone: 301-614-5224
Fax: 301-614-5228
Address: Goddard Earth Sciences Data and Information Services Center
Attn: Help Desk
Code 610.2
NASA Goddard Space Flight Center
Greenbelt, MD 20771, USA

6.2 References

See the NASA GSFC NSSDC entry for the TIROS omnidirectional radiometer radiation data:

https://nssdc.gsfc.nasa.gov/nmc/dataset/display.action?id=ESAD-00152

and the following documents:

Bandeen, W. R., M. Halev, and I. Strange, 1965: “A radiation climatology in the visible and infrared from the TIROS meteorological satellites”, NASA TN D-2534.

House, F. B., “The radiation balance of the earth from a satellite”, Ph.D. thesis, 69 pp., Dep. of Meteorol., Univ. of Wisc., Madison, 1965.

Sparkman, Barbara B., 1964: “Experimental analysis of the TIROS hemispheric sensor”, M.S. thesis, Department of Meteorology, The University of Wisconsin.

Suomi, V. E., K. J. Hanson and T. H. Vonder Haar, 1967: “The theoretical basis for low-resolution radiometer measurements from a satellite”, Annual Report. Grant NBG-27, Department of Meteorology, University of Wisconsin, 79- 100.

7. Appendices

Acknowledgments

The Nimbus data recovery task at the GES DISC is funded by NASA's Earth Science Data and Information System program.

Acronyms

EOS: Earth Observing System

ESDIS: Earth Science and Data Information System

GES DISC: Goddard Earth Sciences Data and Information Services Center

GSFC: Goddard Space Flight Center

L1: Level-1 Data

NASA: National Aeronautics and Space Administration

ORR: Omnidirectional Radiometer Radiance

TIROS: Television Infrared Observation Satellite

QA: Quality Assessment

UT: Universal Time

FORTRAN Code

```
C ^NAME: READ_ORR
C   This program reads TIROS Omnidirectional Radiometer Radiation files.
C
C   The TIROS Omnidirectional Radiometer Radiation files were created
C   only for the TIROS-4 mission. Each record contains a line of
C   ASCII text which make up a series of tables, each with an orbit of
C   data. The tables have two lines of header describing each of four
C   sets of columns, followed by several rows containing measurements
C   taken every 29.5 seconds. This program will print the contents of
C   each data file.
C
C ^MAJOR VARIABLES:
C     FNAME  - name of input file
C     IRECSZ - size of record in bytes
C     BUFF   - buffer for data record
C     IOS    - I/O status number
C
C ^NOTES:
C     Compile: gfortran -o READ_ORT.EXE READ_ORT.FOR
C
C ^AUTHOR:  James Johnson (James.Johnson@nasa.gov), NASA GES DISC
C
C ^HISTORY: November 19, 2021 - first version
C-----------------------------------------------------------------------
      PROGRAM READ_ORT
      CHARACTER FNAME*1024                  ! Filename
      CHARACTER BUFF(120)                   ! Buffer for data record
      CHARACTER*120 LINE                    ! Line of text
      INTEGER*4 IRECSZ                      ! Size of records
      INTEGER*4 IWORD                       ! 4-byte word
      CHARACTER TEMP(4)                     ! Buffer to hold 4-byte word
      EQUIVALENCE (TEMP,IWORD)
      EQUIVALENCE (BUFF,LINE)

C     Get the name of the input data file to read
      WRITE (0, *), 'Enter the name of the input file:'
      READ (5,'(A)') FNAME

C     Open the specified input file
      OPEN (UNIT=1, FILE=FNAME, STATUS='OLD', ACCESS='DIRECT',
     &      FORM='UNFORMATTED', RECL=1, ERR=99, IOSTAT=IOS)

C     Initialize N (record number) and IOFF (byte offset in file)
      N=0
      IOFF=0

C     Loop through the file reading all records in file
      DO

C       Read the first 4-byte word or record size header
        DO I=1,4
          READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
          IRECSZ = IWORD
        END DO
```

```
        IOFF=IOFF+(I-1)
        IF (ISHFT(IWORD,-31) .EQ. 1) THEN                  ! Check Bit 31
          IRECSZ = IAND(IWORD,'7FFFFFFF'Z)
        END IF

C       End-of-File (EOF) mark, break out of do loop
        IF (IRECSZ .EQ. 0) GOTO 90

C       Next read the data record
        DO I=1,IRECSZ
          READ (1, REC=IOFF+I, IOSTAT=IOS) BUFF(I)
          IF (IOS .NE. 0) THEN
            PRINT '("ERROR: BUFF ",I4,X,I4,", IOSTAT: ",I6)', N,I-1,IOS
            IRECSZ = I-1
            GOTO 90
          END IF
        END DO
        IOFF=IOFF+(I-1)
        N=N+1

        PRINT '(A)', LINE(1:IRECSZ)

        DO I=1,4                                           ! Sandstone tape file
          READ (1, REC=IOFF+I, IOSTAT=IOS, ERR=90) TEMP(I)
        END DO
        IOFF=IOFF+(I-1)

      END DO

C     Close the input file
   90 CLOSE(1)
      STOP

   99 PRINT '("ERROR: OPEN FILE, IOSTAT: ",I6)', IOS
      STOP
      END
```